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(54) Title: METHOD AND APPARATUS FOR PRESERVING FOOD

(57) Abstract

The invention comprises a method of pre-processing food prior to a main food preservation process, comprising subjecting the food to a treatment which serves to decrease the viability of any microorganisms in the food. Preferably, the treatment involves blanching the food in an acid solution or mixing an acid into the food. In a further aspect, the invention comprises a method of preserving food, comprising the steps of: (1) subjecting the food to a treatment which serves to decrease the viability of any microorganisms in the food; and (2) subjecting the food to heat in a food preservation process.

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METHOD AND APPARATUS FOR PRESERVING FOOD

TECHNICAL FIELD

The present invention relates to a method for preparation of shelf stable food, particularly meat, vegetables, fruits and products based on meat, vegetables and fruit. More particularly, the present invention relates to a method for resisting or preventing the degradation of food, particularly food stored at ambient temperature over extended periods of time of up to two years or more. Even more particularly the present invention relates to a method for decreasing the viability of undesirable microorganisms and enzymes associated with food to provide an improved shelf stable product, in many cases produced at much lower temperatures and with much reduced periods of heating than many other shelf stabilisation processes resulting in a more organoleptically acceptable product.

Although the present invention will be described with particular reference to the preparation of shelf stable meat, vegetable and fruit and products based on these food groups, it will be readily appreciated by the persons skilled in the relevant technology that the scope of the present invention is not limited to meat, vegetable and fruit and products based on these food groups but rather the scope is more extensive to include food generally, including home replacement meals comprising meats and vegetables, bulk food service portions, unprocessed food such as nuts and pulses, and processed foods such as salamis, cheeses, bread, pastries and the like. The scope of the present

invention also extends to preservation of food for short term as well as long term storage.

The method and apparatus of the invention is not limited to the described arrangement or embodiment but rather the scope is more extensive so as to include other arrangements of the apparatus and applications other than those specifically described.

BACKGROUND ART

Food preservation methods applied to prevent or delay the deterioration of food have been used for centuries. Early hunter-gatherers prepared dried meats such as pemmican and used caves and other cool places to provide refrigeration of their food. Cheese and yoghurt are the products of fermentation, a food preservation technique known from early times. Fruits, vegetables and meat have been preserved by pickling, a process in which food is salted to selectively control microorganisms such as bacteria then fermented to stabilise the treated tissues. Preservation of fruit has also been practiced for centuries by concentrating soluble solids as jams, marmalades and other preserves. The natural and/or added sugar in these foods also acts as a preservative.

Early efforts at food preservation were often effective at delaying food deterioration, but the texture and colour of the food often suffered and the food was often either tasteless or alternatively comprised an overwhelming taste of salts or spices used to preserve the food. The development by Pasteur in

1846 of the food sterilization process now known as pasteurisation was a significant step forward in food processing technology. The rise of the consumer society and advances in food processing technology have radically improved all aspects of food preservation during the twentieth century. Methods of food preservation based on the pasteurisation process such as canning, freeze-drying and irradiation have made enormous progress. Vast numbers of chemicals are also now used in food preservation not only to preserve the food but to improve the colour, taste and texture.

Consumer expectations of preserved foods have risen to a very high level. Consumers quite reasonably expect that they can eat a preserved food at any time before its "use by" or "best before" date without running the risk of infection and sickness caused by harmful microorganisms including certain bacteria, spores, fungi and enzymes. Consumers also expect that preserved food will remain unspoiled and not change in appearance, at least until the "use by date" is reached.

The "use by date" is usually displayed on a the packaging of preserved foods and indicates the date until which the foodstuff should not start to exhibit any significant decrease in quality. Foods which have a use by date at least 2 years after their date of manufacture are referred to as "shelf stable". Shelf stable products are not only in demand from ordinary consumers but are also used as part of army rations, campers' supplies, rescue and relief packages and so forth.

In recent times, consumers have also become very aware of potential health risks associated with the use of unacceptable chemical additives and certain methods of preservation such as irradiation.

Accordingly one of the most popular methods of preservation of food is pasteurisation or sterilization using retort technology because this method does not generally require the use of additives such as chemicals or techniques such as irradiation. Retort technology is based on sterilization of food using heat, for example by heating a product to destroy vegetative cells of various forms of microorganisms such as bacteria that cause spoilage. This form of sterilization can be used with many food products, particularly those with a pH below 4.5, to retard bacterial spoilage.

A typical process for preserving food using retort technology may comprise placing sealed packages of food in a retort and then pressurising the retort while the food packages are submerged in hot water for a period of time sufficient to raise the internal temperature of the food to a predetermined level. In another typical process for preserving food using retort technology, packaged foods traveling on a conveyer belt are sprayed from above and below with heated water until the internal temperature of the food rises to a predetermined level.

One of the problems associated with this type of food preservation is that application of heat for a minimum amount of time suitable to kill bacteria may cause changes in the food that detract from its

appearance. For example, sweet corn or maize has a relatively high natural sugar content, and the application of heat during sterilisation by retort technology tends to caramelise the sugar, thus altering the corn from its natural yellow colour to a caramel colour. Consumers prefer preserved food to have the same appearance as the corresponding fresh food and often associate such a colour change with poor quality.

This problem has been recognized for canned foods, which are often subjected to relatively high temperatures for long periods of time in order to kill microorganisms such as *Clostridium botulinum* which only produces its lethal toxin when it has achieved the vegetative form growing under anaerobic conditions. Thus, in US patent number 4,741,911 there is described a process for canning vegetables in which the vegetables are first blanched in water, then placed in a can and a salt solution including a mixture of an aldonic acid with its lactones is added to the can to cover the vegetables. The can is then sealed and subjected to the usual sterilization process. In this process it is found that the amount of heat necessary to sterilize the vegetables is substantially less than the amount required without the addition of the mixture of an aldonic acid and its lactones to the salt solution contained in the can.

It will be appreciated that when it comes time to consume the canned vegetables, the can is opened and the vegetables are separated from the liquid contents of the can prior to consumption. Hence, the process has limited applicability to other types of food and is

certainly not applicable to those foods which are not stored in a liquid medium. Moreover, it does not lend itself to packaging of foods in other ways such as in clear plastic bags or trays wherein foods appear to be freshly packed with no liquids present other than natural juices.

It has now been found that the preservation of foodstuffs can be greatly improved by a simple method of pre-processing carried out before the main food preservation process such as pasteurisation or sterilisation by retort technology.

DISCLOSURE OF THE INVENTION

According to a first aspect of the present invention there is provided a method for pre-processing food prior to a main food preservation process, comprising subjecting the food to a treatment which serves to decrease the viability of any microorganisms in the food.

In one embodiment of the invention, the treatment which serves to decrease the viability of any microorganisms in the food comprises blanching the food with an acidic solution.

In an alternative embodiment of the invention, the treatment which serves to decrease the viability of any microorganisms comprises mixing an acid into the food.

According to a second aspect of the present

invention there is provided a method of preserving food, comprising the steps of:

(1) subjecting the food to a treatment which serves to decrease the viability of any microorganisms in the food; and

(2) subjecting the food to heat in a food preservation process.

Typically, the food preservation process is pasteurization or sterilization by retort technology.

In general, the pre-processed food is sealed in packaging and the packaged pre-processed food in a heated environment (for example, filled with steam and/or hot water depending on the food), which may also be pressurised. Typically for less dense food easily able to be lowered in pH terms the immersion in hot water or the heating by steam or hot water is sufficient, but food regarded as more dense or more at risk will be heated at a higher temperature in a retort under pressure. The packaging in the retort may be heated by full immersion in water or steam cooked.

The method of the present invention is directed to decreasing the viability of unwanted microorganisms present on foods, and does not necessarily affect the harmless or useful microorganisms present. Commonly however, the method of the present invention will decrease the viability of all of the microorganisms and may also reduce the activity of any enzymes capable of spoiling food found on foods. Foods usually comprise

numerous types of microorganisms and enzymes, some of which may be detrimental, and some of which are harmless or even useful. For example the cheeses (such as blue vein cheeses), salami and sauerkraut owe their taste and long shelf life to useful, naturally occurring microorganisms and enzymes.

It should be noted that the method of pre-processing food of the present invention is directed to the decrease of viability of detrimental microorganisms, that is, those which adversely affect the health of a consumer or which cause degradation of the foodstuff. This requires only that propagation and growth or the microorganism is inhibited. Optimally the microorganism is rendered more sensitive to being killed during subsequent processing. It is not essential that all the detrimental microorganisms be killed by the process of the present invention. With respect to the detrimental enzymes it is not necessary that the enzymes be destroyed but rather that the enzymes are changed such that they cannot chemically react with or cause detriment to the food.

The types of microorganisms whose viability is intended to be decreased by the method of the present invention include micro-flora and micro-fauna such as bacteria, moulds, fungi, yeast and spores.

Most microorganisms and detrimental enzymes are present at or adjacent the surface or skin of foodstuffs. Accordingly it is often unnecessary for the conditions of the pre-processing method to penetrate into the foodstuff far beyond the surface or skin of the

foodstuff.

The types of microorganism present and the degree of detriment caused will vary from foodstuff to foodstuff. Accordingly the method of pre-processing and in particular the environment used with respect to the present invention will vary with the type of food.

The pre-processing takes into account the known growth and survival limits for the microorganisms present on the type of food being processed. The following table (Table 1) lists various species of microorganisms and approximate growth and survival limits where the various other parameters are optimal. For example, the minimum growth temperatures in Table 1 are for growth in optimal, neutral pH, high a_w (water activity) microbiological media.

TABLE 1

Type of microorganism	Min. pH for growth	Min. a_w for growth	Anaerobic growth (e.g. in vacuum pack)	Min. growth in temp. (°C)
Aeromonas hydrophilla	4.0	4% salt	Yes	0
Bacillus cereus	4.4	0.91	Yes	4
Clostriduim botulinum (proteolytic A,B,and F)	4.8	0.94	Yes	10
Clostridium botulinum (non-proteolytic E)	4.8	0.97	Yes	3.3

Type of microorganism	Min. pH for growth	Min. a_w for growth	Anaerobic growth (e.g. in vacuum pack)	Min. growth in temp. (°C)
Clostridum botulinum (non-proteolytic B and F)	4.6	0.94	Yes	3.3
Clostridium perfringens	5.5	0.93	Yes	5
Enterobacter aerogeries	4.4	0.94	Yes	2
Escherichia Coli	4.4	0.9	Yes	4
Lactobacilli	3.8	0.94	Yes	4
Listeria monocytogenes	4.4	0.92	Yes	0.1
Micrococci	5.6	0.9	No	4
Moulds	<2.0	0.9	No	<0
Pseudomonas species	5.5	0.97	No	<0
Salmonella species	3.8	0.92	Yes	4
Staphylococcus aureus	4.0	0.83	Yes	7.7
Vibrio parahaemolyticus	4.8	0.94	Yes	5
Yeasts	1.50	0.8	Yes	.5
Yersinia enterocolitica	4.5	7% salt	Yes	-1.3
Interactions between factors are likely to considerably alter these values				

Source: Campden & Chorleywood Food Research Association; from the Freshline ™ Guide to Modified Atmosphere Packaging, p.26

In yet another embodiment of the invention the pre-processing method may comprise subjecting the foodstuff to an environment comprising a salt solution eg. a spray of a salt solution.

Preferably the pre-processing method of the present invention comprises acidification of the food either by blanching with an acidic solution or mixing an acid into the food.

Typically an acidified blanching solution may be use for fruits, such as apples. Apples have a naturally high acid content and many of the bacteria associated with apples are adapted to tolerate this acid content. However if the level of acid in the environment surrounding the apple is raised during the pre-processing method of the present invention the bacteria die.

Preferably the acid is an organic food acid such as citric acid, tartaric acid, phosphoric acid or gluconic acid and/or its lactones eg. glucono delta lactone.

Typically, the pH of an acidified blanching solution or the pH of the food after mixing with acid is below 4.5, preferably between 4.2 and 4.4.

The method of the present invention for pre-processing food will typically be carried out using a processing apparatus comprising a processing tank into which the food is placed, a reservoir for storage of a

processing liquid which can be added to the tank and optionally a pump for circulating the liquid in the tank, a heater for heating the liquid and detectors/controllers for monitoring and changing physical parameters associated with the environment created in the tank for processing the food. The tank may be able to be pressurised with liquid or gas.

The pre-processing method is not sufficient on its own to provide a shelf-stable product hence further processing is also required. The further processing may comprise any convenient processing for provision of shelf stable foodstuffs, such as sterilization associated with canning or retort technology. A sterilization process may be quite simple but the processing parameters will vary from foodstuff to foodstuff. Where a retort system is being used for sterilization, it is noted that some foodstuffs need full retort processing while other foodstuffs do not require full retort processing. For example, the sterilization process may comprise: i) heating and cooling the pre-stabilized packaged foodstuff in a pressurised retort, ii) heating the packaged pre-stabilised food by an ambient pressure system such as a bath of boiling water, iii) heating via a spiral steam cooker, or iv) heating the foodstuff, putting the foodstuff in sterile packaging and quickly hermetically sealing the packaging as in the canning process.

One of the advantages of the present invention is that the pre-processing may reduce the severity required of the conditions of the main processing. This leads to savings in time and energy expended on the main

processing step, thus contributing to the economy of the process.

It should be noted that the severity of the main processing may be reduced to a level where the main process (or the pre-processing) alone would not provide a shelf stable product, but the combination of the pre-processing method of the present invention plus the main process is sufficient to provide a shelf stable product. In one embodiment the pre-processing method is followed by full retort processing. The food may be subjected to the pre-processing method of the present invention and then the food may be placed in retort quality barrier bags such as those comprising a film of nylon laminated between layers of polypropylene. The bags may then be laid out on trays, allowing for bag expansion during processing. The trays are then placed in a retort and the retort secured. The retort is filled with water to a level near a sensor at the top of the inside of the retort. A vapour space is left for condensation of the heated water. The blowing of steam into the water is then commenced. A circulation pump is started, sucking water from two inlets at the lowest point of the retort and spraying the water back through an opening at the top of th the retort. The recycle time is 5 minutes. The steam blowing is continued until the core of the foodstuff reaches the desired temperature. The hot water is then pumped out and immediately replaced with cold water, reducing the foodstuff temperature to below 55 °C, the temperature at which the cooking process stops.

Typically the apparatus for retort processing

comprises a retort in which the food is placed, hot and cold water reservoirs from which hot and cold water respectively can be pumped into the retort, a boiler for supplying steam to the retort, an air compressor for supplying air to the retort and appropriate sensors and controllers for controlling the supply of water, steam and compressed air to the retort.

In a less rigorous retort processing the packaged food is placed on a conveyor belt which travels slowly through a long (over 8 m) closet. At the end of the conveyor belt the bags drop onto a cooling plate where their temperature is quickly reduced to ambient. In the closet the packaged food may be exposed to heat by spraying hot water or steam such that the internal temperature of the packaging reaches 85°C, and held there for approximately 10 minutes (or more). Later, as the package travels on the conveyer belt the temperature is reduced to approximately 75°C for a further approximately 10 min, this period depending upon the food being processed.

Typically each processing run using the pre-processing method of the present invention will be used for one particular food or type of food. For example, the pre-processing method may be used to process a batch consisting of a single vegetable such as corn or several different types of vegetables such as corn and peas. The pre-processed vegetables may then be packaged and sent for further processing or they may be mixed with other food such as meat, lentils, cereal, flour, rice, pasta or the like, and the mixture is then packaged and subjected to further processing.

Typically the packaging comprises hermetically sealing the pre-processed food in a polymeric bag or other suitable polymeric container. Other containers suitable for processing and storage of the shelf-stable product will be readily apparent to those skilled in the relevant technology. The container may be evacuated or filled with air or alternatively the air may be replaced by another gas such as nitrogen. The process may be used in a typical canning process such that the canning times and temperatures can be reduced owing to the pre-processing stabilisation stage.

MODES FOR CARRYING OUT THE INVENTION

The invention will now be further described by the following non-limiting Examples:

Example 1

Granny Smith apples (100 kg) were peeled, cored, diced and blemished pieces removed. The pieces of apple were then added to an aqueous solution of citric acid at 70°C for 5 minutes at a pH of between 4.2 and 4.4. The pieces of apple were then removed from the citric acid solution, mixed with some sugar and fed into a packaging machine which loaded portions of diced apple into retort bags which were then hermetically sealed. The bags of diced apple where then placed on a conveyor belt and passed through a sterilization closet. The temperature of the diced apple was raised to 60 °C for 5 minutes before the bags reached the end of the conveyor belt and tumbled off the conveyor belt onto a cooling plate where

the temperature of the diced apples was immediately reduced to room temperature.

Example 2

The process of Example 1 was repeated using fresh Granny Smith apples. Instead of passing the bags of diced apple through a sterilization closet, they were placed in a retort which was filled with hot water for a time sufficient to raise the internal temperature of the bags to 60°C for 5 minutes.

Example 3

The method of the present invention was applied to a food manufactured from a recipe which comprised prime sliced meat, soy sauce, egg, starch, wine, sodium bicarbonate, chilli powder, Chinese pepper, five spice powder, mono-sodium glutamate and sugar. The recipe was prepared by separating the ingredients into dry ingredients (which were already free of microorganisms) and wet ingredients. The wet ingredients were combined and thoroughly mixed and the pH of the mixture measured at 6.7. At this pH most microorganisms will grow prolifically if given sufficient nutrients, moisture, temperature and air.

Stabilization Process

To stabilize the microorganisms, the pH of the wet ingredients was lowered to 4.4 by addition of a food acid. The wet ingredients were then blanched for a short period of time in steam. At this point the proliferation of microorganisms had been halted and a

significant number of microorganisms had been killed.

The wet ingredients were then combined with the dry ingredients before portions of the recipe mixture are added to plastic retort bags which were hermetically sealed.

Sterilisation Process

The plastic retort bags containing the recipe mixture were placed into a retort which was then filled with steam. (It is noted that the same sterilization can be carried out by filling the retort with hot water.) The food was exposed to a temperature of 116°C for 35 to 45 minutes at a pressure of 90 to 95 kPa.

The steam was then pumped out of the retort and the retort bags containing the recipe mixture were left to cool over a 5 minute period in the retort before being removed. The food thus prepared was shelf stable and required no refrigeration. No microorganism growth could be detected and the food maintained most of the organoleptic properties of the freshly cooked ingredients.

The food recipe prepared by the process of the present invention was compared with the results of processing the same food recipe using a process of the prior art. The differences between the process parameters for the two processes are summarized in Table 2:

TABLE 2

	Current Process	Prior Art Process
Acidification	Yes	No
Blanching	Yes	Sometimes
Retort Temperature	116°C	121°C
Time	35-45 min	70-90 min
Pressure	90-95 kPa	90-95 kPa

Comparison of the values in Table 2 shows that the current process subjects the food to a lower temperature for a far shorter time compared to the process of the prior art. Accordingly the process of the current invention is not as harsh on the food and is therefore less likely to damage or change the physical or chemical structure of the ingredients. The process of the current invention requires less energy input and is therefore more economical than the process of the prior art.

Example 4

The method of the present invention was applied to a food manufactured from a recipe which comprised prime sliced meat, soy sauce, egg, starch, wine, sodium bicarbonate, chilli powder, Chinese pepper, five spice powder, mono-sodium glutamate and sugar. The recipe was prepared by separating the ingredients into dry ingredients and wet ingredients. The wet ingredients were combined and thoroughly mixed and the pH of the mixture measured at 6.7. At this pH most microorganisms will grow prolifically if given sufficient nutrients, moisture, temperature and air.

Stabilization Process

To stabilize microorganisms, fungi, mould, etc on the food, the wet ingredients were steamed for 2 minutes. Such steaming was sufficient to kill most of the surface organisms mentioned above. At this point the proliferation of microorganisms had been halted and a significant number of microorganisms had been killed.

The pre-processed wet ingredients were then combined with the dry. At this point the pH of the ingredients was lowered by the addition of 1.5% Glucono Delta Lactone diluted in an amount of pure water sufficient to lower the pH of the total ingredients to 4.3. The ingredients were then portioned and placed in retort barrier bags and hermetically sealed.

Sterilisation Process

The plastic retort bags containing the recipe mixture were placed into a retort which was then filled with water. The food was exposed to a temperature of 100°C for 10 minutes then 90°C for 20 min, at ambient pressure.

The steam was then pumped out of the retort and the retort bags containing the recipe mixture were left to cool over a 5 minute period in the retort before being removed. The food thus prepared was shelf stable and required no refrigeration. No microorganism growth could be detected and the food maintained most of the organoleptic properties of the freshly cooked ingredients.

The food recipe prepared by the process of the present invention was compared with the results of processing the same food recipe using a process of the prior art. The differences between the process parameters for the two processes are summarized in Table 3:

TABLE 3

	Current Process	Prior Art Process
Acidification	Yes	No
Blanching	Yes	Sometimes
Retort Temperature	100°C for 10 min then 90°C for 20 min	121°C
Time	30 min (as above)	70-90 minutes
Pressure	ambient	90-95 kPa

Example 5

Pieces of filleted fish were blanched in a hot aqueous solution of citric acid at pH 4.3 for 10 minutes. The pieces of blanched fish were then placed in retort bags and the bags hermetically sealed. The sealed bags were placed in a steam retort for 8 minutes at 114°C at a pressure of 81 kPa. The retort was then flushed with cold water, and the temperature in the bags reduced to ambient for 5 minutes. The retort was then refilled with hot steam to raise the internal temperature of the bags to 114°C for 8 minutes. The retort was then drained and the sealed bags were removed.

Example 6

Pre-process/ Stabilisation process

Red kidney beans were soaked in hot water for 1 h then

blanched in boiling water with a solution of 0.5% citric acid for a period of 4 minutes. The beans were removed from the blanching mixture and all liquid allowed to drain off.

Packing

The red kidney beans were then packed in retort quality barrier bags. The package was heat sealed. (In this and subsequent examples, the packaging may be vacuum packed if desired but it is recommended that any vacuum packing should be limited to 30% to minimise damage and to retain a fresh appearance.)

Sterilisation

The packages were placed in a retort. The retort was filled with hot water and the temperature was increased to 110°C over 7 minutes. Pressure in the retort was kept at 140 kPa. The beans were kept at 110°C for 30 minutes and then were quickly cooled by removing the hot water and replacing it with cold water.

Example 7

The sweet corn was first de-husked and cleaned

Stabilisation

A blanching solution was prepared containing 1.0% citric acid. The blanching solution was brought to boil and the sweet corn was then blanched for 1 minute at boiling point.

Packaging

The sweet corn was then packed in retort quality barrier

bags (though other appropriate packaging could have been used). The package was heat sealed.

Sterilisation

Because the sweet corn is a dense product requiring a higher degree of heat penetration, the sterilization process was carried out in a retort. The packages were placed in a retort, and the retort was filled with hot water to the stage of the come up time taking 7 minutes to achieve a 115°C water temperature at 140 kPa. The sweet corn was held at 115°C for 30 minutes before being quickly cooled by evacuating the hot water and replacing with chilled water.

Example 8

A chilled Chicken and Curry home replacement meal was purchased from a retailer. The meal was tested for its organoleptic qualities and then for its chemical characteristics. The ingredients were found to have a high pH which hence required adjustment in accordance with the present invention.

Stabilisation

A solution of 2% by weight of glucono delta lactone was added to the ingredients sufficient to lower the pH of the ingredients to 4.3, but without substantially altering the basic organoleptic qualities of the meal.

Packaging

The Chicken and Curry meal was then packed in retort quality barrier bags, which were then heat sealed.

Sterilisation

The packaged food was immersed in boiling water (100°C) for 10 minutes and then left to simmer (90°C) for a further 20 minutes. The heated packages were then immediately flushed with chilled water sufficient to cool the contents of the package.

Example 9

Cauliflower was cleaned thoroughly and the florets were separated to sizes suitable for serving.

Stabilisation

A blanching solution was prepared containing 1% citric acid. The blanching solution was brought to boil and the cauliflower blanched for 1 minute. The cauliflower was then immersed in a bath of 1% sodium meta bisulphite at 45°C for 5 minutes.

Packaging

The cauliflower was then packed in retort quality barrier bags. The package was heat sealed.

Sterilisation

The packaged food was immersed in boiling water for 10 minutes and then left to simmer for a further 10 minutes. The heated packaging was then immediately flushed with chilled water sufficient to cool the contents of the package.

Example 10

Ingredients for the manufacture of a hamburger patty were combined, these ingredients including beef combined with egg, flour, garlic, diced onion and spices. The pH of the combined ingredients was determined.

Stabilisation

To the hamburger ingredients a solution of glucono delta lactone was added sufficient to increase the acid level to a pH of 4.3. The hamburger patties were then formed and fried in boiling oil until cooked. The hamburger patties were taken from the fryer and immediately packed.

Packaging

The hamburger patties were packed in retort quality barrier bags. The packages were heat sealed.

Sterilisation

The packaged food is immersed in boiling water for 10 minutes and then left to simmer for a further 20 minutes. The heated packaging is then immediately flushed with chilled water sufficient to cool the contents of the package.

At this stage the product is shelf stable

Example 11

Carrot was cleaned and the skin removed. The carrot was then sliced julienne style.

Stabilisation

A blanching solution is prepared containing 1% glucono

delta lactone. The blanching solution was brought to the boil and the julienne carrot blanched for 1 minute at 100°C.

Packaging

The julienne carrots were then packed in retort quality barrier bags. The packages were heat sealed.

Sterilisation

The packaged food was immersed in boiling water for 10 minutes and then left to simmer for a further 10 minutes. The heated packaging was then immediately flushed with chilled water sufficient to cool the contents of the package.

While the invention has been explained in relation to its preferred embodiments it is to be understood that various modifications thereof will become apparent to those skilled in the art upon reading the specification. Therefore, it is to be understood that the invention disclosed herein is intended to cover such modifications as fall within the scope of the appended claims.

INDUSTRIAL APPLICABILITY

The invention is applicable to methods for resisting or preventing the degradation of food, and so is useful in the food preservation art.

CLAIMS:

1. A method of pre-processing food prior to a main food preservation process, comprising subjecting the food to a treatment which serves to decrease the viability of any microorganisms in the food.

2. A method as claimed in claim 1, comprising blanching the food with an acid solution.

3. A method as claimed in claim 2 wherein the pH of the solution is below 4.5.

4. A method as claimed in claim 3 wherein the pH of the solution is between 4.2 and 4.4.

5. A method as claimed in claim 1, comprising mixing an acid into the food.

6. A method as claimed in claim 5 wherein the acid is applied as an acid solution.

7. A method as claimed in either one of claims 5 or 6 wherein the pH of the food is lowered to below 4.5.

8. A method as claimed in claim 7 wherein the pH of the food is lowered to between 4.2 and 4.4.

9. A method as claimed in any one of claims 2 to 8 wherein the acid is an organic food acid or the acid solution is a solution of an organic food acid.

10. A method as claimed in claim 9 wherein the acid

is, or the acid solution is a solution of, citric acid, tartaric acid, phosphoric acid or gluconic acid and/or its lactones.

11. A method as claimed in claim 10 wherein the acid is, or the acid solution is a solution of, citric acid or glucono delta lactone.

12. A method as claimed in claim 1, comprising treating the food with a salt solution.

13. A method of preserving food, comprising the steps of:

(1) subjecting the food to a treatment which serves to decrease the viability of any microorganisms in the food; and

(2) subjecting the food to heat in a food preservation process.

14. A method as claimed in claim 13 wherein step (1) comprises blanching the food with an acid solution.

15. A method as claimed in claim 14 wherein the pH of the solution is below 4.5.

16. A method as claimed in claim 15 wherein the pH of the solution is between 4.2 and 4.4.

17. A method according to claim 13 wherein step (1) comprises mixing an acid into the food.

18. A method as claimed in claim 17 wherein the acid is applied as an acid solution.

19. A method as claimed in either one of claims 17 or 18 wherein the pH of the food is lowered to below 4.5.

20. A method as claimed in claim 19 wherein the pH of the food is lowered to between 4.2 and 4.4.

21. A method as claimed in any one of claims 14 to 20 wherein the acid is an organic food acid or the acid solution is a solution of an organic food acid.

22. A method as claimed in claim 21 wherein the acid is, or the acid solution is a solution of, citric acid, tartaric acid, phosphoric acid or gluconic acid and/or its lactones.

23. A method as claimed in claim 22 wherein the acid is, or the acid solution is a solution of, citric acid or glucono delta lactone.

24. A method as claimed in claim 13 wherein step (1) comprises treating the food with a salt solution.

25. A method according to any one of claims 13 to 24 wherein the food preservation process is pasteurization or sterilization by retort technology.

26. A method as claimed in claim 25 wherein the food is packaged following the treatment which serves to decrease the viability of any microorganisms in the food

and the packaged pre-processed food is placed in a heated environment for a predetermined time.

27. A method as claimed in claim 26 wherein the packaged pre-processed food is placed in a heated environment which is also pressurized.

28. A method as claimed in claim 26 wherein the packaged pre-processed food is immersed in water or steam cooked.

29. A pre-processed food which has been subjected to treatment in accordance with the method of any one of claims 1 to 12.

30. A preserved food which has been subjected to treatment in accordance with any one of claims 13 to 28.

31. A pre-processed food substantially as herein described with reference to the accompanying drawings.

32. A preserved food substantially as herein desribed with reference to the accompanying drawings.

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 98/00363

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: A23B 4/027, 4/20, 7/005, 7/10, 9/02, 9/26, 9/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

um documentation searched (classification system followed by classification symbols)
AS ABOVE

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
SEE BELOW

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
STN (MEDLINE). KEYWORD:-SPOILAGE.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Journal of Food Protection, Vol. 48, No. 10 pp 838-847 (September 1985) Smulders et al. "Immediate and delayed microbiological effects of Lactic acid decontamination of calf carcases----". See whole document.	1-32
X	Trends in Food Science and Technology June 1996 [Vol. 7]. Ahrenainer, R. "New approaches in improving the shelf life of minimally processed fruit & vegetables. See whole document	1-32

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 August 1998	28.08.98
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer JOHN ASHMAN Telephone No.: (02) 6283 2364

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/AU 98/00363

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	International Journal of Food Microbiology. 6 (1988) 31-42. G.M. van der Marel et al. "Bacteriological quality of broiler carcasses as affected by in-plant lactic acid decontamination". See whole document	1-32
X	INTERNATIONAL JOURNAL OF FOOD MICROBIOLOGY 11 (1990) 305-312 ZEITOUN, A.A.M. et al. "The effect of treatment with buffered lactic acid on microbiological decontamination and a shelf life of poultry.	1-32
X	AU B 52750/86 (582626) (American National Can Company) See whole document	1-32
X	AU B 85627/91 (651625) (Rhone-Poulenc Inc.) See whole document	1-32
X	WO 93/19609 (Vetostar Limited) 14 October 1993.	1-32
X	INT. J. FOOD MICROBIOL, 16, 1992; 275-281 SILLA SANTOS, M.H. et al "The effect of PH on the thermal resistance of Clostridium sporogenes (PA3679) in asparagus puree acidified with citric acid and glucono-delta-lactone"	1-32
X	Appl Environ Microbiol 1997; 63(10) 3764-3769 Cuppers, H.G. et al, "A model for the combined effects of temperature and salt concentration on growth rate of food spoilage molds"	1-32
X	Int. J. Food Microbiol 1995; 25(2): 191-197 Silla Santos, M.H. et al, "Glucono-delta-lactone and citric acid as acidulants for lowering the heat resistance of clostridium sporogene PA 3679 in HTST working conditions.	1-32

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/AU 98/00363

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
AU	52750/86	CA	1277172	DK	418/86	EP	192354
		ES	551306	ES	8800584	FI	860377
		GR	860272	JP	62051972	NZ	214958
		PT	81923	GR	860271		
AU	85627/91	US	5143739	CA	2052343	CN	1068249
		EP	516878	HU	62437	MX	9102493
		NZ	240204	US	5283073	US	5512309
		JP	4365443	US	5262186	US	5192570
		US	5268185	US	5354568	US	5069922
		BR	9405194	CA	2137629	EP	659346
WO	9319609	AU	38978/93	EP	633726		

END OF ANNEX